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BOOK REVIEW

Robert Ayre, *Earthquake and Tsunami Hazards,* 150 pages;

Earl Baker and Joe McPhee, *Land Use Management and Regulation in Hazardous Areas*, 124 pages;

Don G. Freidman, *Computer Simulation in Natural Hazard Assessment,* 192 pages;

Gilbert F. White, *Flood Hazard in the United States,* 141 pages;

Boulder, Colorado: Institute of Behavioral Science, University of Colorado, 1975.

The results of a National Science Foundation sponsored multi-year study of Natural Hazards in the United States conducted at the University of Colorado's Institute of Behavioral Science is in the process of being presented in a series of 20 monographs. The remarks below pertain to the four monographs indicated above. These four are treated here collectively since they are homogeneous and complementary as regards methodologies and the reporting of results.

COMPUTER SIMULATION IN NATURAL HAZARD ASSESSMENT

The heart of the analysis system used in the studies of natural hazards is the computer model and simulation procedures. In this monograph Don Friedman, who drew upon long experience with risk assessment programs for a large insurance firm to develop these models, describes the procedures and assumptions used and how the model results may be interpreted. Overall it is a very clear and convincing statement on data processing and the creditability of the results.

The primary purpose of the models is to simulate the interactions between various hazard adjustments in terms of vulnerability to determine an overall loss potential and evaluate the benefits from changes in the present programs for hazard adjustment.

The modelling procedures begin with development of a static geographic loss potential index based upon recent losses and trends, then a hazard generator is employed, based on historical events of varying strength, to simulate future recurrences. Four factors interact to determine the overall expected loss potential: *the hazard generator, local conditions, population-at-risk, and vulnerability.* The simulation model enables the experimenter to test the net

impact of a hierarchy of changes in adjustments upon losses to be expected, and thus to determine the changes in emphasis that will accrue the greatest benefits. The overall loss potential index is computed in these simulations for a grid system of 85,000 units averaging about 35 sq. miles in size.

The hazard generator is evolved basically on physical not statistical grounds. As an example – for the hurricane hazard it considers the size and shape of maximum wind patterns, the storm size, storm speed, direction and curvature of track relative to the coastal approach, and the loss of strength passing inland due to friction and loss of energy sources. Storm surge and the inland flooding which results is considered and the model is run for hurricanes of several categories to determine the impact on property and population for each of the grid units. Population and property characteristics such as number, type, value, exposure and vulnerability for each grid unit are stored in memory. Vulnerability of property (relative to wind and water) is further broken down into classification groups as to quality of construction, type and age, and whether there is urban or rural exposure, a factor which influences the strength of expected winds. Finally the recurrence locally of events of varying severity is obtained from the hazard generator, and from the resulting simulations. Geographic zones of loss potential are mapped for five categories ranging from "very low" to "very high".

The application of such a sophisticated model to natural hazards over such a vast area as the contiguous 48 states is without precedent. Its power and effectiveness are, of course, dependent upon the knowledge ableness with which the inputs are made to the model. The need for imposing subjective judgements is relatively large. However there is substantial reason for confidence that the model runs have been competently made and that they provide an effective source of information

on severe hazard vulnerability, loss potentials, and the means of restricting or reducing economic and social losses. This endorsement notwithstanding, it must be acknowledged that not all the value judgements concerning model inputs are unassailable. For example, the listing of historical hurricanes which have affected coastal sectors of the U.S., classifies hurricane strength as *minimal, major,* or *extreme* in terms of the highest winds (or lowest pressure) observed *at any time during the life cycle.* It is not uncommon for hurricanes which acquire extreme strength over water to reach the coast as minimal storms; for example, hurricane Carmen (1974) whose central pressure in the Caribbean was 928 mb (extreme) and in the southern Gulf of Mexico 940 mbs (extreme), crossed the Louisiana coast with maximum sustained winds less than hurricane force (minimal). An admirable but controversial attempt to model the storm surge from hurricanes will also fail to find universal support, although the description and general discussion of this phenomenon is quite good.

This monograph, in addition to the fine job it does of explaining the modelling procedures used in assessing research needs, is replete with valuable graphical and tabular information concerning the dimensions, character, and impact of natural hazards in the U.S. all derived from the model, and will prove to be an important reference work.

Overall the monograph series by the Institute of Behavioral Sciences on natural hazards should have a significant impact on planning and administering programs to minimize economic and social losses if for no other reason than that it assembles a massive amount of factual information on the physical character of these hazards, and on the interaction to be expected between the various adjustments most of which are presently supported individually and independently by various government agencies.

Whether the recommendations made will effectively impact federal research policies will very likely depend more on the political expediency with which they are viewed by the incumbent and following administrations than upon the urgency with which the National Science Foundation supports the recommendations of the study it has sponsored. Experience has shown that this in turn is likely to depend upon whether one or more natural disasters of sufficient political importance to the nation occur before obsolescence overtakes these important publications.

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